

Bigger Areas Are Better

Codling moth control program in the Northwest shows coordinated areawide treatments are environment-friendly and effective.

Codling moth, the most destructive pome fruit pest, worldwide, is finally meeting its match.

That match is a 5-year program in the western United States. Now in its third year, the Codling Moth Area-wide Suppression Program aims to suppress this pest over wide growing areas, so that fruit growers can remain competitive.

"It works," says Carrol O. Calkins, an Agricultural Research Service (ARS) entomologist.

"The principal way we control the moth is through the use of synthetic female sex pheromone that growers place in orchards at a rate of 120 to 400 dispensers per acre," says Calkins. "The pheromone so confuses males that they can't find females."

"This ARS-developed mating disruption technology for codling moth control is most efficient when insect populations are low. So some judicious amounts of insecticides are sometimes needed at the beginning of the growing season to lower moth populations if they are high," he says.

Because of codling moth and some concern as well about other minor insect pests, apple and pear growers in the western United States spray their crops with nearly 2 million pounds of insecticides annually. Unchecked, codling moths have the potential to destroy an estimated 80 percent of the Northwest's apple crop



Entomologists Alan Knight (left) and Carrol Calkins examine Golden Delicious apples for codling moth damage. Photo by Scott Bauer (K7617-12).

and 50 percent of its pears. Since most consumers won't accept the occasional worm in the apple, growers and fruit packinghouses lose money if infestation rates are high.

But growers want to cut back their use of pesticides, which cost from \$60 to \$150 per acre. There's also the risk that codling moths will become resistant to currently registered insecticides. And less insecticide use allows natural enemies to attack codling moth and other orchard pests.

"We're extremely pleased with results so far," says Calkins. "Growers are getting excellent control of codling moth, with sharp reductions in pesticide use and fruit damage." Calkins works at the agency's Yakima Agricultural Research Laboratory near Wapato, Washington.

In addition to mating disruption and insecticides, growers have other weapons. They can infect the insects with bacteria or spray infected trees with petroleum oils that coat and kill the insects. The growers can also release factory-reared sterile males that later mate with wild females, rendering the subsequent eggs sterile.

"We also released parasites that attack codling moths on small research plots," says Thomas R. Unruh, ARS entomologist at Wapato. "Up to 1,000 per acre of *Mastrus ridibundus* and *Liotryphon caudatus* (Ichneumonidae) were released on trees in late summer. As a result, up to 60 percent of overwintering codling moths were parasitized by the time they emerged the following spring."

John Biele, a grower who is part of the areawide program in northern Washington, is pleased, too. "We reduced by about half the amount of insecticides applied for codling moth control last year, compared to our needs before the program began,"

says Biele. "This year, we plan on using none or very little. It seems to be working, and lots of people are excited about the progress."

Scientists and grower/cooperators started the areawide program in 1995 with about 2,800 acres of apple and pear orchards at five sites.

Last year, acreage was expanded to include some 3,700 acres. This year,

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Golden Delicious apples are the second most popular apple in the United States after Red Delicious.

another 4,000 acres and five new sites were added.

Each site differs in climate, topography, fruit varieties, and pest densities. Each also has different combinations of secondary pests including leafrollers, leafminers, leafhoppers, lygus and stink bugs, and various mites and aphids.

Oroville, Washington

This site next to the U.S.-Canadian border involves 14 growers and 378

acres. The area previously harbored large populations of codling moths and required frequent insecticide applications during the growing season. After just 2 years in the program, some orchards didn't need any sprays. Overall fruit damage was only 0.04 percent last year, down from an already low 0.2 percent the first year of the program. Credit the release of sterile male codling moths—coupled with pheromones that disrupted mating—for reducing the subsequent need for insecticides.

"We found it's best to release the sterile males from late June into September and to aim for a ratio of at least 40 to 1 of sterile to wild males," says ARS entomologist Alan L. Knight, who is also at Wapato. "But because wild populations were so low last summer, sometimes our release ratio averaged 180 to 1. With each succeeding generation in a sterile release program, the ratio should continue to increase."

Leafroller populations decreased as well. In the caterpillar stage, these insects feed on fruit and leaves. The resulting damage makes the fruit unmarketable. Growers participated in a thorough early-season monitoring and spraying program that included one chemical and one oil spray and two or more applications of *Bacillus thuringiensis* (Bt) spray. This bacterium produces a protein that paralyzes the intestinal tracts of leafrollers.

Amount of leafroller-damaged fruit by the end of the second year was about half that experienced by growers not in the program—0.5 percent versus 0.9 for growers using pesticides.

Howard Flat, Chelan, Washington

All but one of 36 apple and pear growers in Howard Flat participated in the 1,092 acres under study. They

used a hoop to attach pheromone dispensers containing Isomate-C+ on upper tree branches to disrupt mating. Results were impressive. Before the study began, 0.9 percent of the apples and pears suffered codling moth damage. Last year that was down to 0.2 percent damage—even better than the 0.6 percent damage the first year.

“Of the orchard blocks studied, 70 percent had no damage at all. In contrast, the one grower who was not in the program suffered considerable damage,” according to Kelly Denton, who is the Howard Flat coordinator.

Sampling for codling moth populations with sticky traps baited with the lure, Codlemore, indicate when and if control sprays are necessary. The numbers of moths captured in these orchards were reduced by 82 percent from 1995 to 1996.

But leafrollers remained a problem. Though fruit damage averaged only about 0.2 percent, troublesome hot spots persisted. Last fall, Denton sampled bins from different areas in the orchards to identify these spots. This spring, growers used the information to begin early control programs there.

West Parker Heights, Washington

There are close to 450 acres of apples and pears in this study area involving seven growers. In addition to the Isomate-C+ pheromone dispenser to disrupt mating, a second one, Checkmate-CM, was used on about half the acreage.

Overall, codling moth damage was reduced at this site too. As at the other sites, most damage was caused by the second generation of insects.

“Two orchards actually had worse damage the second year than the first. That shows how difficult it can be to accurately predict problem areas,” says Wapato entomologist Bradley S. Higbee. “We even placed the traps higher in the tree canopy, doubled

their density, and deployed different types in an effort to get a more accurate sample.”

Despite these two damaged orchards, insecticide sprays were reduced last year to an average of one application—down from three the year before. Almost half the test site didn’t need any spray, while growers who were not in the program applied five to six.

Some growers had more damage

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Entomologist Brad Higbee (left) and technician Chey Temple assess codling moth damage on Red Delicious apples.

from leafrollers than from codling moth—about twice the levels as conventional growers. Despite stepped-up efforts to reduce populations from the first year’s level, they yielded mixed results. The growers found it very hard to accurately monitor overwintering larvae and to gain control with additional Bt applications.

Pear psylla (the major insect pest of pears), leafhoppers, and leafminers didn’t pose serious problems for

growers in either of the test years.

Medford, Oregon

The Medford site has 6 growers with 400 acres under production—up 100 acres from the first year. Most of the site is devoted to pears, but last year apples were included for the first time. The pear growers are using a “soft” approach that relies on oil in the growing season and oil plus lime sulfur sprays before bloom, in addition to mating disruption.

Overall, codling moths were well controlled in 1996, with only 0.04 percent fruit damage at harvest. While pear psylla and mites were no problem, leafroller populations concerned growers. The leafrollers were concentrated in certain areas, sometimes in areas that previously posed no problem. Lygus and stink bugs were also problem insects, inflicting more damage in 1996 than in 1995.

“We are challenged by insect problems on this site. This year, we plan to monitor and control what’s happening in weeds and shrubs surrounding our orchards. We suspect this vegetation is serving as a reservoir or refuge for secondary pests while control efforts are under way in the orchards,” says Laura Naumes, who is the site coordinator.

Other current weaknesses at the site include an inability to correctly predict codling moth and leafroller damage, monitor natural enemies of the insects, and reliably sample and control secondary pests like lygus bugs.

Naumes says that while damage to both test site and nearby orchards not in the program was nearly the same, the costs for IPM were lower.

Randall Island, California

In the Sacramento River Delta region, Randall Island includes 760

contiguous acres of pears, mainly Bartlett, operated by five growers. The program here actually began 2 years earlier than at the other sites, in an attempt to not only control large populations of codling moths but to find ways to slow codling moths' inevitable increase in resistance to Guthion [azinphosmethyl], the insecticide of choice for the growers in the study. This resistance to Guthion in codling moths was first detected at Randall Island in the late 1980s.

During the past two growing seasons, there was a 71-percent reduction in pesticide use in orchards where mating disruption was applied, compared to conventional orchards. Fruit damage from codling moths and leafrollers was limited to less than 1 percent each. Other secondary pest infestations remained low as well. These included pear psylla, the European red mite, two-spotted mite, and pear rust mite.

Leafrollers have not historically been a problem for these growers, but in 1996 their presence necessitated some insecticide applications. Mites and psylla seemed to be under control with an application of abamectin, a commercially available insecticide.

This year, growers will try a single application of Isomate-C+ just when the first generation of codling moths begins flight. This will be followed by one application of an organophosphate spray at the peak of their flight.

Three of the existing sites were expanded for 1997 (Oroville, Chelan, and Medford), and five new ones were added. Four of the new sites are in Washington (Brewster Flat, Progressive Flat, Manson, and West Wapato) and one is in California (Ukiah).

"Each new site presents growers and scientists with a different challenge," says Calkins. "For example, oblique-banded leafrollers are a seri-

ous pest at the Brewster Flat site but not at others. Some sites are hilly; others, more rolling or flat. Uneven topography makes it difficult to determine how to place the pheromone dispensers so the active ingredient evenly penetrates the tree canopy to reach all the codling moths."

The ARS scientists continue their research to resolve additional problems that have occurred during the Codling Moth Areawide Suppression

farm and pest control advisors, the Washington Tree Fruit Research Commission, Washington Apple Commission, and Winter Pear Control Committee.—By **Dennis Senft**, ARS.

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Technicians Bill Greenwood (left) and Jamie Foster (right) and entomologist Brad Higbee inspect for damage from codling moths or other insect pests before shipping apples to the packinghouse.

Program. These include nonpesticide control of aphids, leafhoppers, leafminers, leafrollers, and pear psylla by use of insect growth regulators and biological control techniques.

In addition to ARS, cooperators include Washington State University, Oregon State University, University of California at Berkeley, as well as